PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in Reusable Locking Means for Turbine or Compressor Rotor Assemblies

We, GENERAL ELECTRIC COMPANY, a Corporation organized and existing under the laws of the State of New York, of 1 River Road, Schenectady 5, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention pertains to locking devices for turbine or compressor rotor assemblies, and more particularly to a locking device which may be reused an indefinite number of times.

Conventionally, a rotor blade, is mounted in a turbine or compressor rotor wheel by means of a root portion at the base of the blade, which is received in slidable relationship in a slot formed transversely in the periphery of the wheel. The root and slot are formed congruently with a "fir-tree" or other irregular cross-section to restrain the blade against disassembly from the slot, other than by sliding transversely to the wheel. Locking means must therefore be provided to restrain the blade in assembled relation in the slot. The locking means should be readily removable to permit the replacement of worn blades. While a number of such devices have been proposed, they are generally subject to at least one of three objections; either they require complex and relatively expensive forming methods, or removal and replacement of the blades is a complicated and time-consuming process and requires special tools, or the locking means cannot be re-used following blade replacement.

The object of this invention is to provide improved locking means for turbine or compressor rotor assemblies, which may be readily assembled and disassembled without tools, are economical to manufacture, and are reusable an indefinite number of times.

In accordance with the invention, a locking means is provided for a turbine or compressor rotor assembly having a rotor wheel formed with a plurality of blade receiving slots extending transversely across and through the rotor wheel rim for retaining a plurality of blades having root portions slidably received in said transverse slots, wherein the radially inner surface of the rotor wheel rim is provided with an undercut groove extending circumferentially thereabout and opening radially inwardly, the blade root portions being similarly formed with transverse arcuate undercut grooves opening radially inwardly, the blade root grooves aligning with the undercut groove in the wheel rim when the blades are in an assembled position to form a continuous annular groove, and wherein an expansible snap ring is removably seated in the annular groove to restrain the blades against sliding movement relative to the rotor wheel slots. The snap ring is formed with an axially extending tab for manual removal of the snap ring from the annular groove, the wheel rim being formed with a notch extending exteriorly from the undercut groove therein for receiving the tab in an exteriorly accessible position.

In the accompanying drawings,

Fig. 1 is a pictorial view of a cutaway portion of a turbine or compressor rotor wheel incorporating the improved locking means;

Fig. 2 is an elevation in cross-section of a portion of the rotor wheel, with blades removed;

Fig. 3 is a plan view of a cutaway portion of the rotor wheel, with blades removed, viewed radially inwardly toward an axis of the wheel and

Fig. 4 is a side view of a cutaway portion of the assembly of Fig. 1.

Referring to the drawings, a turbine or compressor rotor wheel 1 is provided for rotatably supporting a plurality of blades 2. Blades 2 may comprise compressor or turbine blading, and are suitably formed in a conventional manner for the purpose intended. Each of blades 2 is formed with a root portion 4, terminating in a platform 5. Each root portion

[redacted]

4 is formed at a point spaced from its ends with an arcuate groove 7, extending transversely across the root portion to form an overhanging lip 6.

Rotor wheel 1 is formed as a body of revolution about an axis (not shown) and is mounted, in a manner well known in the art, for rotation about that axis. The rotor wheel is formed with an enlarged annular rim 10 to provide means for mounting blades 2. Rim 10 projects axially from the body of wheel 1 to form radially outer and inner surfaces of revolution 10*a* and 10*b*, respectively. As shown, rim 10 is cut away to form a recess 9 for the purpose of lightening the structure, but this is not necessary to the practice of the invention. Rim 10 terminates axially in plane faces 11 and 12, for cooperation with conventional sealing means (not shown) in a turbine or compressor assembly.

In order to mount blades 2 in rim 10, the rim is formed with a plurality of blade-receiving slots 13, extending transversely across the rim and across outer surface 10*a*. Slots 13 are formed with a series of convolutions 14, terminating in an apex 14*a*, in an undercut configuration of uniform cross-section conventionally known as a "fir-tree". Root portions 4 are formed with a uniform convoluted cross-section congruent with that of slots 13, and are thus receivable in the slots in transversely-slidable relationship to rim 10. The convoluted form of the slots and roots serves in a well-known manner to restrain the blades against motion relative to the rim, other than sliding movement along the slots.

According to the invention, improved removable locking means are provided to retain blades 2 in an assembled position in slots 13. For this purpose, radially inner rim surface 10*b* is formed with an undercut groove 15 extending circumferentially thereabout and opening radially inwardly, spaced along the surface to provide an overhanging annular lip 16, interrupted at circumferentially-spaced intervals by slots 13. Groove 15 intersects slots 13, extending radially outwardly from apex 14*a* across convolutions 14. Groove 15 and arcuate grooves 7 of roots 4 are so located that they are aligned as a continuous annular groove in the assembled relation of blades 2 in rim 10. Similarly, lip 16 and lips 6 of roots 4 are aligned to form a continuous annular overhanging lip in the assembly.

To complete the improved locking means, an expansible snap ring 18 is provided having a free diameter somewhat greater than that of groove 15. Snap ring 18 may be formed of spring steel, or other deformable material having high elasticity, and is in the shape of an annulus interrupted at a gap 19. For convenience in grasping the ring, we prefer to form a tab 20 at an end of the ring adjacent gap 19. A notch 21 is cut through lip 16, extending exteriorly from groove 15 at a point spaced between slots 13, to receive tab 20 and provide convenient access to the tab for removal of snap ring 18. Tab 20 also cooperates with notch 21 to restrain rotation of gap 19 into conjunction with a slot 13, which would weaken the integrity of the structure.

In the assembled position of the snap ring in groove 15, blades 2 are retained in slots 13 against relative sliding motion by the cooperation between arcuate grooves 7, groove 15, and compressed snap ring 18 lying therein. Lips 6 and 16 retain the snap ring against axial disassembly from rim 10, when the snap ring is in its expanded condition. Rotation of wheel 1 contributes centrifugal force to the compression force of the snap ring to maintain the assembled relation of the parts more securely. For this reason, the snap ring may be sufficiently flexible to permit manual removal, if desired.

Removal of blades 2 from wheel 1 for inspection or replacement is readily accomplished by grasping tab 20, compressing snap ring 18 to the position shown in dotted lines at 18^1 and 20^1 in Fig. 1, and removing it axially from the rotor assembly. Blades 2 may then be removed by sliding them out of slots 13. Re-assembly is accomplished with equal facility by reversing this procedure. Snap ring 18 may be re-used an indefinite number of times to re-lock the rotor assembly.

Alternatively, assembly may be still further facilitated by making snap ring 18 sufficiently flexible to permit insertion of the blades in slots 13 subsequent to positioning of the snap ring in groove 15. As each blade is assembled in a slot, root portion 4 locally presses the snap ring radially inwardly, and the snap ring will resiliently snap outwardly into arcuate groove 7 as the blade reaches its assembled position in the slot.

WHAT WE CLAIM IS:—

1. Locking means for a turbine or compressor rotor assembly having a rotor wheel formed with a plurality of blade receiving slots extending transversely across and through the rotor wheel rim for retaining a plurality of blades having root portions slidably received in said transverse slots, characterized in that the radially inner surface of the rotor wheel rim is provided with an undercut groove extending circumferentially thereabout and opening radially inwardly, the blade root portions being similarly formed with transverse arcuate undercut grooves opening radially inwardly, the blade root grooves aligning with the undercut groove in the wheel rim when the blades are in an assembled position to form a continuous annular groove, and that an expansible snap ring is removably seated in the annular groove to restrain the blades against sliding movement relative to the rotor wheel slots.

2. Locking means according to claim 1 characterized in that the snap ring is formed

with an axially extending tab for manual removal of the snap ring from the annular groove, and that the wheel rim is formed with a notch extending exteriorly from the undercut groove therein, the notch receiving the tab in an exteriorly accessible position.

3. Locking means as claimed in claim 1 substantially as described with reference to the accompanying drawings.

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894,704 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG 1

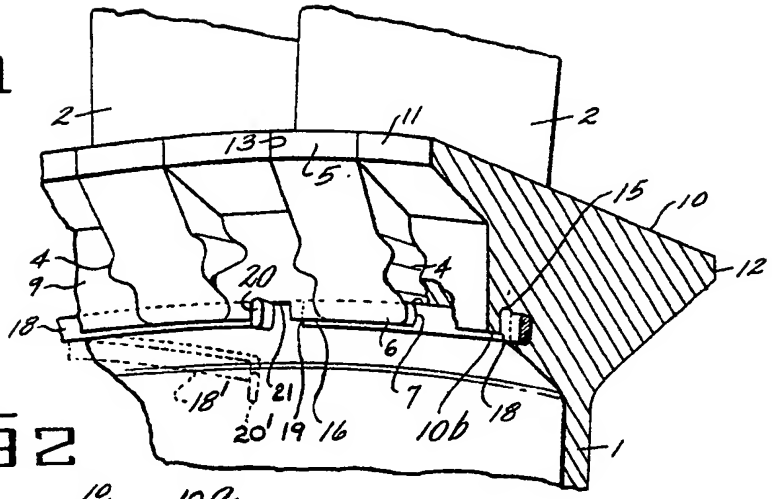

FIG 2

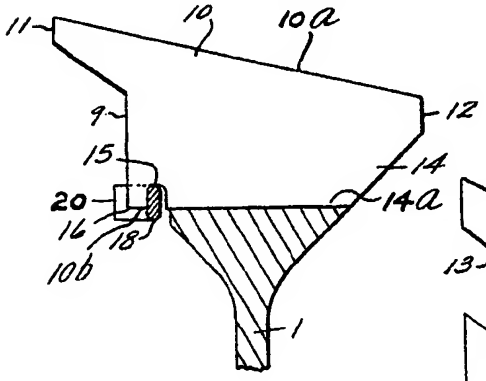

FIG 3

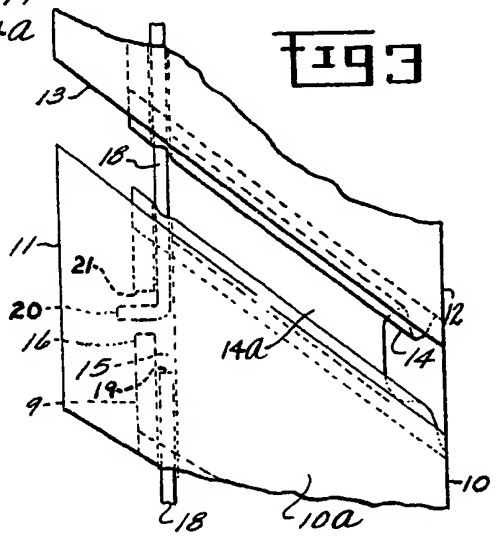

FIG 4